**This document describes the associated (and provided) files used to run WRF simulations for Stanford et al. (2023) and the modifications to the WRF source code needed to create the stochastic mixing scheme. Results within Stanford et al. (2023) can thus be reproduced following the instructions in this document and utilizing the corresponding files. Further questions can be directed to McKenna Stanford via email:** [**mws2175@columbia.edu**](mailto:mws2175@columbia.edu)**.**

* WRF Version: Advanced Research WRF (WRF-ARW) v3.9.1 (available at <https://www2.mmm.ucar.edu/wrf/users/download/get_source.html>).
* The namelist.wps and namelist.input files contain all information needed for the model setup used for all simulations with horizontal grid spacings (Δh) of 3 km on a 1200 km x 1200 km domain centered over Gan Island, Maldives (0.68 ˚S, 73.13˚E).
  1. All variable options in namelist.input are described in detail at <https://esrl.noaa.gov/gsd/wrfportal/namelist_input_options.html>.
* The following files from WRF-ARW v3.9.1 source code were modified to produce the stochastic mixing scheme:
  1. module\_diffusion\_em.F
  2. module\_first\_rk\_step\_part2.F
  3. solve\_em.F
* The unmodified form of these files can be found through the following two paths emanating from the WRF-ARW v3.9.1 raw download:
  1. WRFV3/dyn\_em/module\_diffusion\_em.F
  2. WRFV3/dyn\_em/module\_first\_rk\_step\_part2.F
  3. WRFV3/dyn\_em/solve\_em.F
* The modified files module\_diffusion\_em.F and module\_first\_rk\_step\_part2.F are included in this dataset. Lines within these files that are modified for stochastic mixing are appended with the comment !MS. Performing the Unix command diff for the attached, modified files and the original files from the WRF-ARW v3.9.1 raw download will yield the changes necessary to produce the stochastic mixing scheme.
* Table 1 describes each of the simulations included in Stanford et al. (2023). The *multiplicative factor (F)* column shows the factor to be multiplied by the variable xkmh inside module\_diffusion\_em.F within the smag2d\_km subroutine in order to produce the desired simulation.

Table 1. Description of simulations from Stanford et al. (2020).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Simulation/Ensemble Name** | **Multiplicative**  **Factor (*F*) in module\_diffusion\_em.F** | **Horizontal Grid Spacing (**Δh**)** | **# of simulations** | **Spatial Autocorrelation Scale (δ) [km]** | **Temporal Autocorrelation Scale (τ) [s]** |
| BASELINE | N/A | 3 km | 1 | N/A | N/A |
| BASELINE\_1KM\_CG | N/A | 1 km | 1 | N/A | N/A |
| 4X | 4 | 3 km | 1 | N/A | N/A |
| NO\_MIXING | 0 | 3 km | 1 | N/A | N/A |
| θ-pert | N/A | 3 km | 5 | N/A | N/A |
| STOCH\_LONG | 2\*\*(rand\_pert(i,k,j)) | 3 km | 5 | 10 | 10000 |
| STOCH\_SHORT | 2\*\*(rand\_pert(i,k,j)) | 3 km | 5 | 300 | 600 |

* Each member of the STOCH\_SHORT and STOCH\_LONG ensemble members differ only by the random number seed (iseed\_rand\_pert) within namelist.input used to initialize stochastic simulations. To run various stochastic realizations, this parameter must be changed to a different integer.
* For the STOCH\_SHORT and STOCH\_LONG ensemble members, the spatiotemporal autocorrelation scale is defined in namelist.input using the lengthscale\_rand\_pert parameter and the timescale\_rand\_pert parameters.
  + For STOCH\_LONG ensemble members, lengthscale\_rand\_pert = 300000 and timescale\_rand\_pert = 10000.
  + For STOCH\_SHORT ensemble members, lengthscale\_rand\_pert = 10000 and timescale\_rand\_pert = 600.
* All simulations initialized stochastic mixing at the beginning of the simulation.
* All Δh = 3 km simulation used a 3-second dynamic time step.